Calcium intake of Asian and Caucasian Adolescents in Hawaii

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Abstract

The purpose of this study was to assess calcium intake of Asian and Caucasian adolescents in Hawaii, food and beverage sources of calcium, and key factors influencing calcium intake. Data were gathered in a cross-sectional survey of 51 adolescents and included two 24-hour recalls per person. Mean calcium intakes were below the U.S. Dietary Reference Intake's Adequate Intake level for calcium; still, they were higher than nationally reported calcium intakes of this age group. Although ethnic differences in dietary calcium intake were not seen between the Asian and Caucasian/Other group, the sample size may not be large enough to demonstrate a difference. Asians in Hawaii consumed more calcium than in previous studies. Caucasian/Other group consumed more non-fat milk than the Asian adolescent group. The Caucasian/Other group and the higher socio-economic group consumed more calcium from dietary supplements than Asians and the lower-socioeconomic group. A higher calcium intake was found on the weekday in comparison with the weekend (Sunday), which was largely due to calcium intake from school meals.

Introduction

Adolescence is an opportune time to build peak bone mass. Maintaining a high peak bone mass prevents fracture during adolescence and in the postmenopausal years.[1] Adolescents are physiologically able to absorb and retain more calcium than children and young adults.[2]

In 1997, the new Dietary Reference Intakes (DRIs) for calcium were established, taking into consideration levels needed to prevent future osteoporosis.[3] The new DRI for calcium for adolescents, ages nine to 18 years is an Adequate Intake (AI) level of 1300mg/d. Assessments of calcium intake in the National Health and Nutrition Examination Survey III (NHANES III) report that 52% percent of males and 19% of females, ages nine to 19 years, met the 1989 calcium RDA of 1200 mg/d.[4] NHANES III data collected on calcium intake of Asians, Native Hawaiians, or Other Pacific Islanders were "statistically unreliable" due to small sample size.

Asians have been identified as the ethnic group with the lowest calcium intakes.[1,5-6] Although dietary assessment of Asian calcium intakes have been done in a few studies, the information is limited. Wang et al.[5] determined calcium intake using a food frequency questionnaire that had been validated only on white women. A food frequency questionnaire was also used by Barr,[6] but it did not include Asian foods.

The purpose of this study was to identify calcium intake of Asian and Caucasian adolescents in Hawaii, food and beverage sources of calcium, and key factors influencing that intake.

Methods

This study was part of an ongoing regional U.S. Department of Agriculture (USDA) project titled "Factors Influencing the Intake of Calcium Rich Foods Among Adolescents" (W 191, 1996-2002). This regional component of the national study received institutional review and approval by the University of Hawaii Committee on Human Subjects.

A total of 51 subjects were recruited from the University Lab School in Honolulu, which selects students to represent Hawaii's diversity in ethnicity, socioeconomic status, and educational achievement. The sample size and age groups selected were determined by the protocol of the regional USDA project to allow comparison of comparable age groups in other regions of the USDA study.

The sixth grade class, n = 26 (aged 10 – 12yrs), and one of two tenth grade classes, n = 25 (aged 14 – 16 yrs), were recruited. Based on data gathered from school records, students were classified as Asian if they were greater than one half Asian, based on their parent's ethnicity. In the case of a 50/50 mixture, the mother's ethnicity was used based on the assumption that diet is more typically influenced by mothers than fathers. The ethnic background of the students was generally mixed (as is typical in Hawaii): Asian ethnicities included Japanese, Chinese, Filipino, and Korean. Caucasian ethnicities included: Caucasian, Spanish, English, Polish, and French. Four subjects did not meet the criteria for either Asian or Caucasian and were classified as 'Other'. 'Other' ethnic groups included Marshallese, Hawaiian, and African American.

Socioeconomic status (SES), based on their parents' profession, was obtained from University Laboratory School records as five levels: 1 = welfare, 2 = fixed low income/blue collar, 3 = white collar/clerk/fireman, 4 = small business owner/manager, and 5 =

professional/attorney; subjects were then grouped into a lower SES group (levels 1- 3) and a higher SES group (levels 4 – 5) for comparison.

The study design was cross-sectional. Dietary interviews were conducted twice with each subject within a two and a half week period, selecting two different days of the week. Two 24-hour recalls of food/beverage intake were obtained from each student, reflective of Sunday through Thursday intake (interviews were done Monday through Friday). The number of days between recalls, per student, varied from one to 11 weekdays apart (not counting the weekends in between). No student recalled the same day of the week both times. Dietary interviews were conducted in person in a classroom at the University Lab School and lasted from 20 – 45 minutes per recall. Subjects were not aware of the focus on calcium.

The CSFII survey diet methodology[7] was used. Plastic food models and measuring equipment were used to assist subjects in their assessment of food and beverage serving sizes. The CSFII survey includes questions about the intake of supplements. In the analysis, if brand names were not identified, 200 mg calcium was used for the multivitamin/ mineral supplements and 400 mg for calcium supplements, based on our review of available children's supplements. The CSFII method also included the question, "Do you have any food allergies that make it necessary to avoid certain foods?"

Dietary recalls were analyzed using the Genesis® R & D Version 4.5 (ESHA Research, Salem, OR). Defaults were created for food items not available in the database and for food items that had an unclear description by the child or interviewer (e.g., "white cheese"). The mean percent calcium intake per food group was calculated for the following: milk, cheese, ice cream/frozen yogurt, pudding, yogurt, combination foods, and non-dairy foods. The milk category included all types – white, flavored, and different percentages of fat. Combination foods consisted of mixed food items with an added dairy product (e.g., pizza, cheeseburger). Foods that did not fit into these categories were considered to be non-dairy food sources. Beverages were categorized as white milk, chocolate milk, fruit drinks, soda, water, and 'other beverages'. Fruit drinks included only non-citrus fruit drinks. 'Other beverages' included fruit juices.

Data were analyzed using SPSS® Version 8 (SPSS Inc, Chicago Illinois). Calcium intake, age, and gender were compared by Asian and Caucasian, and Asian and Caucasian combined with the 'Other' group, since the 'Other' group was composed of only four children. The results of these statistical analyses were not different and the Caucasian and 'Other' groups were combined for all further analyses. For the statistical comparison of means, the independent and paired samples (for weekend and weekday) t-tests were used. Chi-Square tests were used for comparison of categories. All values in the text and results presented in figures are expressed as mean±standard error.

Results

Among the 51 subjects, 26 were males and 25 were females. They included 14 Caucasians (27%), 33 Asians (65%), two African Americans (4%) and two Pacific Islanders (4%). There were 28 subjects in the low SES group and 23 in the high SES group. A marginal difference was found in SES between ethnic groups ($\chi^2 = 2.77$, $p < 0.09$); the lower SES group (n = 28) contained a greater proportion of Asians (75%, n = 21) than would be predicted from their proportion of the full sample (65%).

Overall mean daily calcium intake was 1113±491 mg (range: 364 – 2366 mg). Differences in mean calcium intake for the Asian (1045±81 mg) and Caucasian/Other group (1239±124 mg) were not statistically significant ($p<0.181$). The top three food sources of calcium consumed by adolescents in Hawaii are milk, non-dairy foods and combination foods (Figure 1). Significant differences were not found for food sources of calcium by age, gender, or ethnicity.

Types of milk consumed were compared by age, gender and ethnicity. Non-fat milk composed a smaller proportion of total milk intake in Asians than in Caucasians/Other (16% and 38%, $p<0.04$) as shown in Figure 2. Although the Asian group consumed more chocolate milk than the Caucasian/Other group, this was not found to be significant. Difference between the types of milk consumed by age and gender were not significant. Subjects in the younger age group (10-12 yrs.) consumed a significantly greater amount of 2% milk than the older age group (14-16 yrs, $p<0.001$).

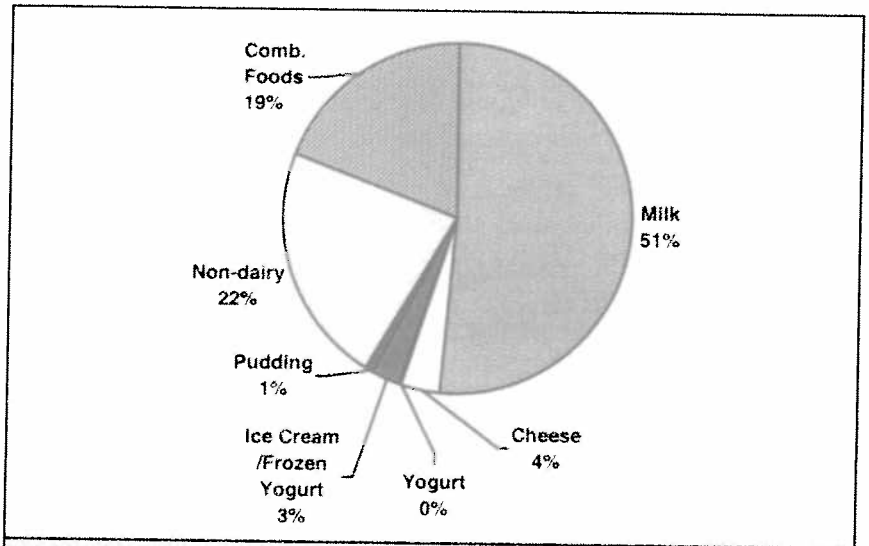

Figure 1.— Food Sources of Calcium consumed by Adolescents in Hawaii (n = 51), expressed as % of Mean Daily Dietary Calcium Intake (1113±49 mg/d)

Differences among the types of beverage consumed were also examined between age, gender and ethnic groups. The older age group consumed less white milk (ml) than the younger age group (384±77 vs. 849±135; p<0.004). Water consumption (ml) was much higher in the males than in the females (1975±374 vs. 939±16; p<0.016) and in the 14 -16 year old age group versus the 10–12 year old age group (1957±371, vs. 959±174; p<0.02). Females consumed a higher amount of other beverages (ml) than males (615±156 (females) vs. 272±74 (males); P<0.004) and fruit drink (ml) beverages than males (472±88 (females) & 162±56 (males); p<0.004).

Twelve (24%) of the 51 subjects consumed school breakfast, which included milk (2%, non-fat, or 1% chocolate) and high calcium menu items (e.g., cheese pizza pocket = 250 mg of calcium). Forty-four (86%) consumed school lunch. Twelve (24%) percent consumed both school breakfast and lunch.

Calcium from school lunch made important contributions to mean calcium intake. Milk was often the top contributor to mean calcium intake on weekday diet records (Figure 1). Cheese pizza pocket (250 mg/serving), breakfast pocket (200 mg/serving), frozen french toast (127 mg/2 slices), sweet buns (35 mg/1 bun) and corn dog (102 mg/1 each), were frequently consumed school lunch menu items providing calcium. Calcium-fortified orange juice consumed at home, was also a source of non-dairy calcium for these adolescents (350 mg/8 fl oz).

The number of weekends reported (always Sunday) equaled about half the number of weekdays (25 of the 51 adolescents had one of their interviews on a Monday to recall Sunday food intake). Mean calcium intake was greater on weekdays than on Sundays (1306 ±124 mg/d and 822±112 mg/d; t = -3.158, p< 0.005, Figure 3). Mean calcium intakes of Asians who had a Sunday diet recall (767±154 mg/d, n = 16) did not differ significantly from the Caucasian group with a Sunday recall (n = 9) (919±151 mg/d; t = -2.951, p<0.525, n = 9). No significant difference was found between Asian and Caucasian calcium intakes on weekdays (Asian, 1178±100 mg/d and Caucasian, 1266±118 mg/d; t = 0.842, p<0.590). However, the sample size for adolescents with a weekend was fairly small and therefore may not be large enough to demonstrate a significant difference.

Twenty-two of 51 subjects (43%) consumed supplemental calcium, 13 from a multivitamin and nine from a calcium supplement. Those who consumed a calcium supplement (n = 9) had a marginally greater mean calcium intake (diet + supplement) than those who did not consume a calcium supplement (n = 42) (1493±159 mg/d with supplement and 1195±73 mg/d with no supplement); t = 1.597, p <0.117). The Caucasians/Other group were found to supplement with more calcium than the Asian group however differences were not significant (p<0.115). Calcium intakes from diet + supplements were higher among those in the high S.E.S. group (p<0.064). Food allergies reported included cow's milk (n=1, Asian student), fish/shellfish (n=3), kakimochi rice crackers with nori seaweed (n=1).

Discussion

Mean calcium intake of the 51 subjects (1113±491 mg) was lower than the calcium DRI for this age group (1300mg/day), but was greater than previous studies (61 – 183 mg higher).[5-6,8-10] The greater calcium intake observed with this sample is likely due to significant consumption of calcium rich food and beverages in school breakfast and lunch and a methodology that

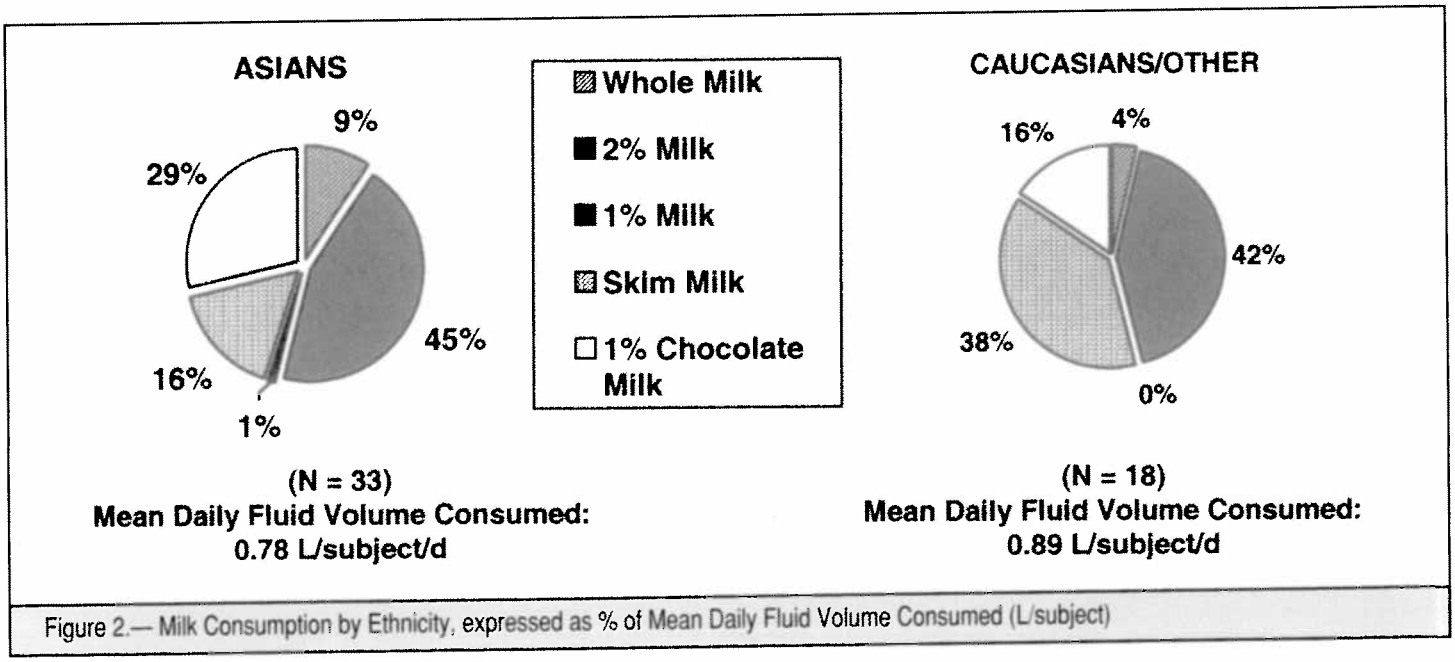

Figure 2.— Milk Consumption by Ethnicity, expressed as % of Mean Daily Fluid Volume Consumed (L/subject)

captured non-dairy calcium sources. Forty-four (86%) of the 51 adolescents consumed school lunch and 12 (24%) consumed both school breakfast and school lunch. Hawaii is ranked eighth in the nation for participation in school meal programs (93%).[11] The impact of the school meal programs was also reflected in the higher mean calcium intakes observed on the weekday in comparison with the weekend. On the weekend, milk may not be frequently consumed due to other options for beverages (e.g., soda, juice).

Mean calcium intake for this sample exceeded that typically reported in national studies by 60 – 180mg/day. However, mean calcium intakes did not differ between Asians and Caucasians aged 10 – 16 in this sample representative of this age group in Hawaii. The only apparent difference between ethnic groups was for the type of milk consumed. The Caucasians/Other group consumed a significantly greater proportion of non-fat milk when compared with the Asian group ($p<0.04$). In a previous study, 'taste' was found to be an important motivator to consume calcium rich foods and chocolate milk was preferred by adolescents.[12] Although this study did not gather subjective information related to preference for foods related to taste, it may be important to study the availability of different of milk in a larger population.

Availability of different types of milk (white vs. chocolate) may influence the choice of adolescents to consume milk with their school lunch versus other types of beverages (i.e., soft drinks).

The Dietary Guidelines for Americans 2000, recommend limiting added sugars to prevent dental caries and obesity.[16] Added sugars may displace consumption of milk products and fruits. The combined proportion of soda and fruit drinks (beverages defined as having added sugar), for the entire sample of adolescents was almost equivalent to the proportion of white milk consumed (18% and 19% of mean daily fluid intake, respectively). The concern for the added sugars associated with chocolate milk consumption is valid, however, chocolate milk is calcium rich (>200mg per serving). In comparison with other high sugar beverages, chocolate milk has less sugar and its calcium content is similar to that of white milk. To meet adolescent calcium intake needs, 4.5 (8 fl.oz.) servings of chocolate milk would supply almost the full, recommended calcium intake (1296mg), this number of servings would also contain 47g of added sugar.

Although lactose intolerance was only found in one student (2%), lactose intolerance may be a barrier to milk consumption for some in this population. However, studies have shown that at least 240 ml of whole or non-fat milk can be consumed by African American adolescents with lactose intolerance.[13,14] These studies also build on previous research shown in lactose intolerant adults.[15]

No significant difference was found in calcium supplement use by ethnicity. However, differences in calcium intakes from diet + supplements between the low S.E.S. and high S.E.S. group approached significance ($p<0.064$). On average, the high S.E.S group obtained 187 mg from supplements and the low S.E.S. obtained 92 mg. A higher S.E.S was associated with an increase in dietary calcium intake in Barr's Study[6] and the CSFII survey.[7] The potential significance of this observation requires further study.

Stang et al.,[17] found that supplement intake did not differ by income ($p<0.09$). However, a positive trend was noted between daily supplement users and income level. This increased supplementation could have contributed to the increased calcium intake seen as income levels increased in the CSFII 1994 – 96 study. Also, a higher SES or income level may be associated with a higher educational level and an increased knowledge of the benefits associated with calcium supplements.

Further analysis of the association of socioeconomic status and calcium intake should be explored in other schools. This could be done by reviewing calcium intakes of adolescents who received free or reduced price school breakfast/lunch in comparison with adolescents who do not. Weekday calcium intakes are greater than the weekend intake, which may be due to the availability of high calcium foods in school meals and participation in the school meal program. This study suggests that calcium food availability at school meals is important in meeting children's calcium needs. This suggestion may be used to encourage consumption of school meals and to advocate for funding of school food service. Additionally, attention to adolescent preferences and nutrition education about calcium may help children and adolescents to optimize their calcium intake at school breakfast and lunch.

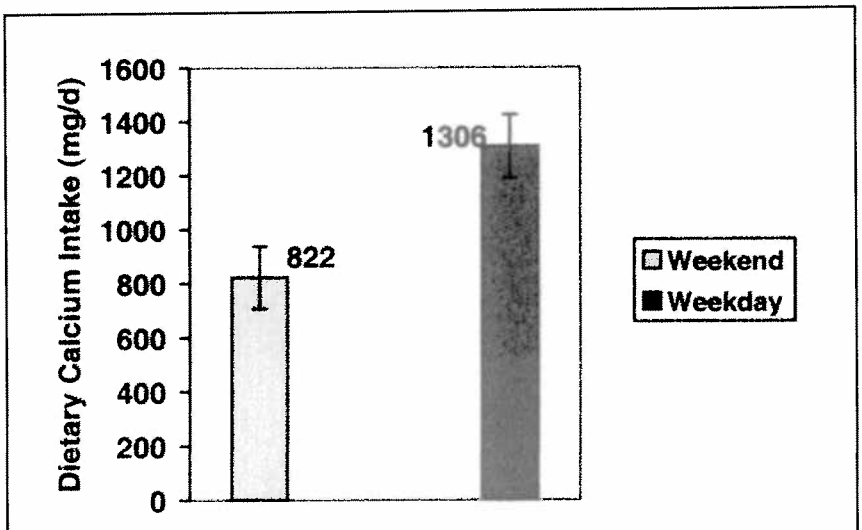

Figure 3.— Mean (+SE) Dietary Calcium Intake on the Weekend (Sunday) and Weekday (N=25)

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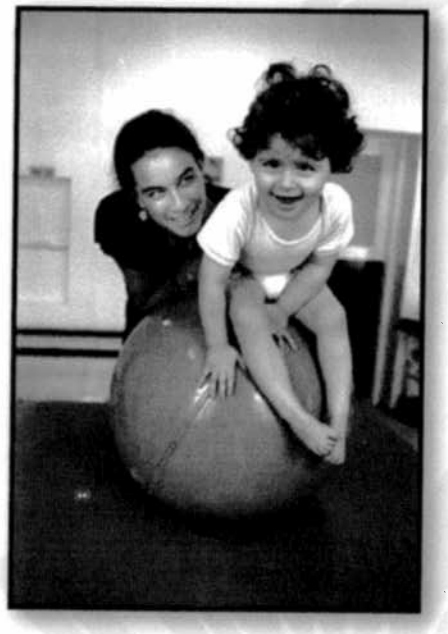

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